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"Experience First": Investigating Co-creation Experience in Social Product Development Networks

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Abstract:

Social product development (SPD) is a network-based innovation model in which firms or platforms use social mechanisms and social technologies to mobilize organizationally independent individuals—co-creators—to co-create new products. SPD networks require the maintenance of external participation across the innovation cycle to survive competition and thrive in the innovation sector. While prior research suggests that the viability, survivability, and productivity of social networks generally depend on user experience, we have limited evidence on the particular role of user experience in the context of SPD networks. Responding to this need, we introduce a conceptual model to theorize and operationalize co-creation experience in SPD networks. Through validating the proposed model, we demonstrate why co-creation experience is critical for predicting co-creators' behavioral intentions and maintaining their actual contribution. Finally, we explore the theoretical and practical implications of the results. Future studies can leverage the findings to better capture co-creation experience and contribute to designing successful SPD networks.

Keywords: Open innovation, Social product development, Co-creation, Ideation, Collaboration, Socialization, Experiential benefits, Human-computer interaction, User experience, Instrument.

1   Introduction

Open innovation business models that social technologies enable extend the opportunities for individuals to participate in innovation projects to creative crowds, who can then participate in innovation processes while being geographically dispersed (Nambisan, Lyytinen, Majchrzak, & Song, 2017; Ramírez-Montoya & García-Peñalvo, 2018). These distributed innovation models have a transformational capacity to help businesses draw on diverse individuals' creativity and interest in innovation to develop new products and services and to bring these products and services to market more quickly and at a reasonable cost (Barrett, Davidson, Prabhu, & Vargo, 2015; Lee, Olson, & Trimi, 2012; Leenders & Dolfsma, 2016). Among open innovation models, the social product development (SPD) model taps into the talents of individuals interested in innovation to access new product ideas, reduce innovation costs, facilitate product commercialization, and reduce time to market. These external (to the firm or platform) talents or *co-creators* represent the main resource for SPD projects (Saldanha, Mithas, & Krishnan, 2017).

Co-creators refer to personally motivated, organizationally independent, and socially connected individual members of SPD networks. They generally have an interest in one or more innovation tasks across the new product development cycle from ideation to commercialization. They come from diverse backgrounds to work collectively on problems presented to, or proposed by, SPD network members (West & Bogers, 2017; Wilhelm & Dolfsma, 2018). SPD *platforms* enable the co-creation process, and SPD *sponsors* facilitate co-creation governance and resource integration (Hossain & Islam, 2015; Lusch & Nambisan, 2015). SPD sponsors blend social mechanisms and social technologies to mobilize co-creators in submitting their product ideas, collaborating in product design, sharing their knowledge with other co-creators, and even contributing to commercialization.

The success of SPD networks depends on many factors, such as the number of submissions, the diversity of co-creators, and the quality of the contributions (Chen, Marsden, & Zhang, 2012; MacGregor & Torres-Coronas, 2007). Among these factors, the SPD literature suggests that the sustained participation of co-creators constitutes a key factor in network success (Kohler & Nickel, 2017). SPD networks need to maintain co-creators' participation across the innovation cycle in order to compete with traditional firms and other platform-based networks. The innovation platform requires this sustainable engagement in co-creation to thrive through ongoing innovation with products and services. Research on SPD has not yet explored all key factors beyond individual motivation that may influence co-creators' sustained participation in an SPD platform; hence, an opportunity to more fully explain post-adoption behavior in this context exists (e.g., Belenzon & Schankerman, 2015; Tsinopoulos, Sousa, & Yan, 2018; West & Bogers, 2014). We believe that, while motivation affects the initial decision to join, co-creation experience better explains why co-creators continue to participate in an SPD network. Co-creation experience also constitutes a key factor that determines the quantity, quality, and continuity of contributions (Sauermann & Franzoni, 2015).

Earlier research suggests a positive relationship between new idea submission behavior and co-creators' length of experience (Chen et al., 2012), but little research has examined the potential relationship between the quality of experience and co-creator contribution (e.g., Nambisan & Watt, 2011). Prior research also suggests that the viability, survivability, and productivity of social networks depend on user experience. However, user experience (UX) research has yet to address co-creation experiences and the experiential benefits of using SPD platforms, the consequences of those experiences, and the ways in which experiences and consequences connect to each other (Hornbæk & Hertzum, 2017; Jaakkola, Helkkula, & Aarikka-Stenroos, 2015). We suggest that we need to better understand the experiential benefits that affect co-creators' participation to improve SPD outcomes (Füller & Matzler, 2007), particularly because companies' investments in these communities continues to grow (Füller, Hutter, & Faullant, 2011; Han et al., 2012; Kolomiiets, Krzyżanowska, & Mazurek, 2018).

In this paper, we focus on the experiential benefits of participation in SPD, and, therefore, we address positive co-creation experience. In this context, we define *co-creation experience* as the set of psycho-cognitive sentiments about the experiential benefits of SPD engagement. SPD engagement refers to the interactions between the co-creators and the SPD environment, including SPD processes (e.g., ideation), entities (e.g., community members and sponsors), and artifacts (e.g., digital platforms). Co-creation experience contributes to subjective judgments about expected and actual gains (experiential benefits) based on previous engagement, or expectations of such, with SPD. With this definition, we broadly conceptualize co-creation experience in a way that incorporates a holistic view of SPD and its possible experiential benefits beyond traditional utilitarian-hedonic models. This broader conceptualization offers a

baseline for better understanding SPD as a unique form of open innovation. Table 1 summarizes how we conceptualize the key terms we use in this study.

Table 1. Definition of Key Terms

Concept	Definition
Social product development	Network-based innovation model in which firms or platforms use social mechanisms and social technologies to mobilize individuals (co-creators) in support of new product co-creation.
Co-creators	Personally motivated, organizationally independent, socially connected individual members of SPD networks who have an interest in one or more innovation tasks across new product development cycle from ideation to commercialization.
SPD sponsors	Central resource integrators who use social mechanisms and social technologies to mobilize co-creators and govern SPD process.
SPD platforms	IT artifacts that enable the SPD process and facilitate resources integration and co-creation governance.
Co-creation experience	Set of psycho-cognitive sentiments about the experiential benefits of SPD engagement.

This paper proceeds as follows. In Section 2, we review the unique aspects of SPD and discuss why we need to understand co-creators' experience to maintain the productivity of SPD networks. In Section 3, we develop hypotheses about the importance of co-creation experience in explaining co-creators' post-adoption behavior. To test these hypotheses, we explain how we modeled co-creation experience from the perspective of experiential benefit, contextualized the model for SPD settings based on the results of our initial case review, and operationalized and validated the measurement model using a pre-test and a pilot study. In Section 4, we report the measurement model validation; the final model is a second-order construct that comprises five subscales (emotional experience, learning experience, professional experience, social experience, and utilitarian experience). In Section 5, we present our results from testing the hypotheses, which provides empirical evidence on how co-creation experience shapes co-creators' behavioral intentions and actual contributions. In Section 6, we discuss our findings and discuss the study's practical and theoretical contributions. Finally, in Section, 7, we discuss the study's limitations and opportunities for future work.

2   Theory

2.1   Social Product Development

Developments with open innovation have helped socially enabled innovation networks such as Quirky and Edison Nation to emerge. In these networks, individuals with common interests come together on digital platforms to co-create new products, services, or solutions. The popularity and diffusion of social technologies have helped these networks to democratize innovation for creative individuals who work outside organizational boundaries (Martini, Massa, & Testa, 2012; Tien & Cheng, 2017). The SPD business model exemplifies such a development. Unlike other open innovation models, SPD relies heavily on social technology tools (e.g., networking, sharing, meta-voicing) and social mechanisms (e.g., reciprocity, community building) to mobilize members to initiate and contribute to new product development projects (Peterson & Schaefer, 2014). Unlike crowdsourcing models in which a firm outsources specific micro-tasks (e.g., Amazon's Mechanical Turk), SPD is a user-driven, product-centric, and participatory approach to new product development (Bertoni, Chirumalla, & Johansson, 2012; Chisty, 2011). In SPD networks, co-creators can submit new product ideas and lead ideation; they can also participate in designing and improving the product concepts that other co-creators propose. The co-creators also help the SPD sponsor with selecting products to manufacture and bring to market. The SPD sponsor acts primarily as a resource integrator by bringing new products to market and sharing profits and risks with network members. Hence, an SPD sponsor not only co-creates value with individual co-creators but also shares economic value with co-creators (Kohler & Nickel, 2017).

SPD business models build on the earlier open innovation models (Chisty, 2011; Peterson & Schaefer, 2014), but one can distinguish these SPD models from typical open innovation models in several ways. First, SPD business models do not pose strict boundaries between sponsors and individual co-creators. Co-creators are neither independent from the network like open innovation marketplaces nor isolated from the project like crowdsourcing platforms. Second, co-creators are socially rather than structurally (e.g., as

employees or customers) engaged in an innovation community, and, therefore, their participation is organic instead of formally transactional (Paulini, Murty, & Maher, 2013). Third, SPD networks blend social media and open innovation to co-create value through social exchange rather than through formal governance (Peterson & Schaefer, 2014). Finally, SPD differs from innovation networks such as open source communities, crowdsourcing firms, or innovation brokers in terms of the variety and prominence of innovation activities that are open to external participation (Leenders & Dolfsma, 2016; Piller, Vossen, & Ihl, 2012; Wu, Rosen, Panchal, & Schaefer, 2016). For example, while in a typical open innovation network only the ideation process is open to external participation, SDP networks engage co-creators in post-ideation processes such as product development, refinement, marketing and commercialization. Therefore, co-creators play more prominent roles in the SPD process than in other open innovation networks.

In these various ways, SPD networks approach co-creation by opening a variety of tasks and activities to co-creators, fully developing and using co-creators' capabilities, offering a higher level of responsibility for innovation processes to co-creators, and promoting project ownership and close collaboration among co-creators. Thus, the approach results in a distinctive and complex co-creation experience compared with other individual-level open innovation networks.

2.2 Co-Creation Experience in SPD

The high level of co-creator involvement in the SPD process provides several experiential opportunities that, if realized, can positively affect the co-creation outcome (Lusch & Nambisan, 2015). Lee et al. (2012) identify co-creation experience as one of the three elements of designing and governing a successful innovation network. Research also shows that co-creation experience is important across the innovation cycle (i.e., from ideation, through product development, to commercialization) (Füller et al., 2011). Even though ample evidence suggests the importance of co-creation experience in other contexts (Mathis, Kim, Uysal, Sirgy, & Prebensen, 2016), researchers have yet to fully examine SPD's experiential component (Vorbach, Müller, & Poandl, 2019).

SPD communities compete globally to engage creative individuals by offering compelling co-creation experience opportunities. These experiences are more relational than transactional. Unlike other forms of open innovation—for example, exchanging ideas for cash rewards in innovation contests (Peterson & Schaefer, 2014)—value co-creation in SPD is not limited to utilitarian transactions between members and innovation sponsors. SPD networks offer experiential benefits through co-creation opportunities by optimizing competition and maximizing social exchange in the network (Wu et al., 2016). For example, in an SPD network, co-creators compete to have their ideas advanced for development, but they also work cooperatively to help advance each other's ideas and to socialize in the process. Therefore, the co-creators may experience non-utilitarian aspects of innovation even without successfully contributing to a new product. Furthermore, these non-utilitarian aspects of co-creation experience have a central role in engaging and retaining co-creators, especially when utilitarian values are difficult to attain (see, Novak, Hoffman, & Duhachek, 2003). SPD platforms with limited experiential benefits may risk evoking little interest among individual co-creators in participation (Füller et al., 2011; Nambisan & Watt, 2011).

While researchers have claimed that providing compelling co-creation experiences could be instrumental to ensuring that co-creation succeeds, only a few empirical studies have operationalized the construct in contexts such as virtual customer communities (Fuller & Söderlund, 2002; Kohler, Fueller, Matzler, Stieger, & Füller, 2011; Lusch & Nambisan, 2015). Furthermore, few studies have empirically investigated co-creation experience with specificity and detail related to the innovation context (Nambisan & Watt, 2011)—possibly due to the limited domain and tight structure of co-creation activities that exists in more highly studied innovation networks, such as crowdsourcing platforms. To investigate user experience in SPD, a broader conceptualization of co-creator experience should encompass a holistic and inclusive approach of the SPD process and its possible experiential benefits (Jain, 2003; Pallot & Pawar, 2012). Experience theory provides a theoretical lens to do so (Nambisan & Watt, 2011).

2.2.1 Co-creation Experience Definition

In the last decade, we have seen an increasing body of conceptual research on user experience based on experience theory (Dewey, 1958), cognitive psychology (Pinker, 1999), human needs theory (Sheldon, Elliot, Kim, & Kasser, 2001), self-determination theory (Deci & Ryan, 1985), and hedonic behavior theory (Hirschman & Holbrook, 1982). As a result, researchers have recognized that one should not limit user experience to a digital artifact's usability or functionalities (Norman, Miller, & Henderson, 1995) and, thus,

have shifted their focus to user interactions' emotional, subjective, and temporal aspects to depict the overall user experience (Alben, 1996; Lallemand, Gronier, & Koenig, 2015). Putting experience before functionality advances our understanding about user experience beyond simplistic ideas about ease of use, utility, efficiency, and beautification and embraces the necessity of making technology-related experience more meaningful as a whole (Hassenzahl, 2010). This approach requires that one redefine and contextualize experience based on the actual environments for user interactions with technology (Javahery & Seffah, 2012; Kieffer, 2017).

To define co-creation experience, we first assume that an individual's interactions with an environment—a co-location of entities and artifacts—constitute the source of human experience in the relevant contexts (e.g., Dewey, 1958; Pinker, 1999). Then , we consider here four common characteristics of co-creation experience that the user experience literature suggests: 1) experience results from human interaction with the digital artifact, 2) individuals subjectively form experience by comparing the expected and actual gain (experiential benefits), 3) both personal and situational factors influence experience, 4) individuals accumulate experience over time (Hassenzahl & Tractinsky, 2006; Kohler et al., 2011; Pucillo, Cascini, Milano, Giuseppe, & Masa, 2014; Wright, McCarthy, & Meekison, 2003). In light of these characteristics, we conceptualize co-creator experience as the psycho-cognitive sentiments about SPD engagement's experiential benefits. This conceptualization does not limit the co-creation experience to a rational evaluation of interactions but rather includes the co-creators' experiential gains based on, for example, how they perceptually, emotionally, and socially evaluate the engagement's consequences (Pucillo et al., 2014). Since this conceptualization focuses on experiential gains, we interpret the gain as a positive experience and its absence as a negative experience (i.e., negative disconfirmation of expectation) (Bhattacherjee, Logistics, & Operations, 2004). We use this approach to distinctly operationalize co-creator experience.

2.2.2   Co-creation Experience Dimensionality

In order to identify and measure experience, information systems (IS) and HCI researchers have traditionally used experiential benefits as a basis and followed the marketing convention of using hedonic perceptions of human-computer interactions as indicators (Chitturi, Raghunathan, & Mahajan, 2008; Deng, Turner, Gehling, & Prince, 2010; Hornbæk & Hertzum, 2017; Van der Heijden, 2003). The notion of experience, however, has too much complexity to survive this oversimplification (Law, Van Schaik, & Roto, 2014). It has such complexity because human interactions are multidimensional and individuals perceive them subjectively based on the context in which they occur (Youngman & Hadzikadic, 2014). We draw on cognitive science to understand and break down this complexity (Varela, Thompson, Rosch, & Kabat-Zinn, 2017). Dewey (1958) observed four types of experiential benefits that result from human interactions: bodily, social, intellectual, and emotional experiences. Cognitive researchers improved Dewey's experience theory and presented a more holistic view of experiential benefits; namely, sensory perception, feelings and emotions, creativity and reasoning, and social relations (e.g., Pinker, 1999). Researchers later adopted this approach to further investigate co-creation experience's significance (Franke & Shah, 2003; Jeppesen et al., 2006; Kohler et al., 2011). Four types of experiences were cited most frequently: pragmatic experience, sociability experience, usability experience, and hedonic experience (Chen, Yang, & Tang, 2013; Nambisan, 2011; Nambisan & Nambisan, 2008). Moreover, IS research revealed the determining influences that these experiential benefits have on different aspects of value co-creation, such as accessing, integrating resources, establishing relationships, and shaping the collaboration (Akaka, Vargo, & Lusch, 2012; Nambisan & Watt, 2011). Similarly, HCI research reported the role that experiential benefits have in shaping users' emotional response (Hylving, 2017; Sheng & Joginapelly, 2012).

Prior research has also discussed experiential benefits in the co-creation context (e.g., Siau, Nah, Mennecke, & Schiller, 2011). For example, co-creators engage in creative activities to experience feelings such as competence, autonomy, and enjoyment (Dahl & Moreau, 2007; Füller et al., 2011) or to experience values such as professionalism, self-efficacy, and socialization (Nambisan & Nambisan, 2008). Likewise, Kohler et al. (2011) showed the importance of pragmatic, sociability, and hedonic benefits in shaping co-creation experience and driving co-creation behavior. These experience opportunities can be professionally interesting, positively challenging, and intrinsically enjoyable, and, therefore, they may increase co-creators' attention, engagement, and persistence in co-creation (Franke & Shah, 2003; Hertel, Niedner, & Herrmann, 2003; Nambisan & Watt, 2011; Wasko & Faraj, 2000). Research also suggests that experiential benefits, such as social benefits, can boost one's intention to co-create value (Jeppesen & Frederiksen, 2006; Nambisan & Nambisan, 2008). Positive co-creation

experience may also affect how individuals judge the efficacy (i.e., satisfaction) that they derive from the successfully completing a creative project (Füller et al., 2011) or may their utilitarian gain from reflecting on their participation or collaboration (Prilla, 2017). This form of experience may contribute to a perception of self-efficacy in co-creation and encourage further participation (Füller et al., 2011; Nambisan & Watt, 2011).

While these studies help explain co-creation experience, they do not sufficiently explain SPD participation for two main reasons. First, these studies focus only on simple co-creation contexts, such as a customer virtual community or a virtual reality experience, where the nature of participation and engagement do not compare with SPD networks as we discuss above. Second, prior research has focused on the influence that experiential benefits have on co-creators' attitudes rather than their actual co-creation behavior and outcomes, and, thus, it falls short when explaining how to encourage sustainable participation. To clarify the need for further investigation, we discuss the influence that co-creation experience has on SPD outcomes in Section 3 and develop our hypotheses.

3   Research Model and Hypotheses

Experience, in terms of confirmation or disconfirmation of expectations, represents perhaps the most important determinant of behavior (Bhattacherjee & Premkumar, 2001; Khalifa & Liu, 2003). Future behavior represents an emotional or rational response to the gap between prior expectations and actual gain (Bhattacherjee et al., 2004). Experience literature suggests that positive experience associated with confirmation of expectations has a causal relationship with satisfaction and future behavior (Köbler, Goswami, Koene, Leimeister, & Krcmar, 2011; Law et al., 2014). That is, in our context, co-creation experience—experiential benefits gained from either contribution to or interactions in an SPD network—influences co-creators' expectation about future involvement and, thus, shapes their future behavior. Prior studies in psychology and cognitive science have confirmed that post-adoption behavior may result from realizing the experiential benefits of past experience (Hirschman & Holbrook, 1982; Pinker, 1999). IS literature also confirms this claim in different contexts (e.g., Bourgonjon et al., 2013; Wang, Zhou, & Zhang, 2014).

The innovation literature has also reported the relationship between co-creation experience and behavior. For example, Füller et al. (2011) explained that the lack of compelling co-creation experience possibly explains co-creators' lack of effective participation or creative contributions. Co-creators' prior experiences of co-creation could also influence their engagement with the SPD community (Zhang, Kandampully, & Bilgihan, 2015). For example, Nambisan and Watt (2011) empirically showed that experience shapes co-creators' attitude and their behavior in online product communities. Accordingly, we expect a relationship between co-creation experience and co-creation behavior in SPD networks. However, the nature of this relationship remains unclear and merits further examination.

To understand the behavioral consequences of experiential values in an IT-enabled environment, the IS and HCI literatures both suggest identifying the key activities that users perform (Hornbæk & Hertzum, 2017; Kieffer, 2017; Näkki & Koskela-Huotari, 2012). These activities constitute the sources of experience, and their experiential outcomes constitute the triggers of behavior. To investigate the key co-creation activities, we adopted three general dimensions of collaborative innovation activity: creativity, collaboration, and communication (Gloor, 2006).

SPD networks refer to creativity as *ideation*; that is, co-creating new product ideas (Romero, Molina, & Camarinha-Matos, 2011). Füller et al. (2011) empirically showed the positive relationship between co-creators' experience and the quality and quantity of ideation. Previous studies in open source communities have also revealed that participation retention and ideation quality are associated with co-creators' earlier achievements (Hertel et al., 2003; Lattemann & Stieglitz, 2005; Roberts, Hann, & Slaughter, 2006).

Collaboration involves interactions between internal and external co-creators to address problems and find or improve solutions (Piller et al., 2012). Intention to collaborate depends on how comfortable and confident the individual feels about the collaboration process and outcomes of past experience (Camarinha-Matos & Afsarmanesh, 2011). A lack of positive experience may inhibit collaborative interaction and negatively affect the perception of risk (Abhari, Davidson, & Xiao, 2018).

SPD represents a distributed form of value co-creation; therefore, *socialization* in terms of information exchange, knowledge sharing, and professional networking plays a critical role throughout the key

processes (Paulini et al., 2013). Socialization in the SPD context shapes co-creators' experience and affects their future behavior (Piller, Schubert, Koch, & Möslein, 2006; Roser, 2013).

Unlike typical open innovation communities that mainly focus on ideation contests, an SPD platform equally values and enables ideation, collaboration, and socialization (Leenders & Dolfsma, 2016; Wu et al., 2016). Further, SPD platforms emphasize *continuous* ideation, collaboration, and socialization (Abhari, Davidson, & Xiao, 2017). Sponsors typically govern open innovation communities, such as innovation contests, as innovation marketplaces and emphasize high-quality one-time ideation. As a result, individuals submit new product ideas to innovation sponsors individually with no or limited input from the community. Therefore, these ideas have a limited chance to evolve through co-creation iteration. In contrast, the SPD process requires meaningful interactions—including ideation evaluation—and ongoing contribution from the co-creators due to its explorative and iterative nature. This consideration suggests that continued participation has far more importance than one-time quality submission. The co-creators' ongoing participating in ideation, collaboration, and socialization can respectively maintain the network's productivity, the outcome's quality, and the community's dynamism. Therefore, we model the relationship between co-creation experience and continuous participation according to three main co-creation behaviors: ideation, collaboration, and socialization.

Accordingly, we postulate that co-creation experience has a direct relationship with continuous intention to ideate, collaborate, and socialize (see, Wang et al., 2014). To support this claim, we use the theory of goal-directed behavior, which explains that goal intention (or decision to perform an activity) at a given cognitive stage involves considering the potential benefits from pursuing certain goals based on one's prior experience (Conner & Armitage, 1998). Recent developments in reason-action theory also suggest that the experiential aspects of attitude can predict behavioral outcomes (Fishbein & Ajzen, 2010). Both the IS and HCI literatures have also frequently reported the relationship between prior experience and continuous intention (Chang, 2013; Deng et al., 2010; Ontinuance, Hirt, Limayem, & Cheung, 2007; Wilson & Lankton, 2013). Therefore, we hypothesize that:

H1: Co-creation experience positively affects continuous intention to ideate.

H2: Co-creation experience positively affects continuous intention to collaborate.

H3: Co-creation experience positively affects continuous intention to socialize.

Prior technology acceptance literature has extensively validated the relationship between intention and behavior (e.g., Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003). Accordingly, we expect that co-creators' continuous intention to ideate, collaborate, and socialize predicts co-creators' actual contribution. Actual co-creation in SPD contexts refers to the measurable individual contributions to new product development. These contributions have direct implications for an SPD platform's effectiveness, which depends on co-creators continuously submitting or improving new product ideas (Füller, Hutter, Hautz, & Matzler, 2014). For example, a higher continuous intention to ideate may lead to a greater number of new idea submissions. We also project that the higher the intention to collaborate, the greater the number of contributions to other new product ideas that other community members will propose. These collaborative contributions come in different forms that range from direct commenting or voting on a new product idea to explicitly contributing to a product idea during product design (Coelho, Nunes, & Vieira, 2016). A higher intention to collaborate may also lead a team of co-creators to collaboratively ideate. Likewise, a higher intention with respect to socialization may contribute to a higher rate of contribution (Sarmah, Kamboj, & Kandampully, 2018). Co-creators socialize in SPD networks to find suitable collaborators, solicit support, and seek advice. Socialization also enhances knowledge sharing in the community (Mariano & Awazu, 2017; Reypens, Lievens, & Blazevic, 2016). Therefore, higher intentions toward ideation, collaboration, and socialization may result in co-creators' newly submitting, evaluating, and disseminating ideas, which would enhance actual contributions to SPD networks. Therefore, we hypothesize that:

H4: Intention to ideate positively affects the actual contribution.

H5: Intention to collaborate positively affects the actual contribution.

H6: Intention to socialize positively affects the actual contribution.

The attitude-behavior consistency paradigm (Fazio & Zanna, 1981) explains the mechanism that underlies the influence that co-creation experience has on the actual contribution. The IS literature has validated the mediating role that intention has on the relationship between experience-driven attitude and behavior (Tsai & Bagozzi, 2014). Researchers have found attitude to predict general behavioral patterns (Fazio &

Zanna, 1981). Individuals develop attitude towards a situation, which their direct behavioral experience shapes, as a mental state of readiness to respond or react to that situation (Allport, 1935; Fazio & Zanna, 1981). Researchers have shown direct behavioral experience to have more predictive power for continuous intention than attitude (Wu & Kuo, 2008). Hence, we can expect that prior experience has the same influence on continuous intention as attitude does since both render expected benefits (Ajzen, 1991; Ajzen & Fishbein, 1980). Moreover, the behavioral psychology literature suggests that attitudes that individuals form from behavioral experience can better predict how individuals develop a response such as approach or avoidance (Davis, 1993; Fazio, Zanna, & Cooper, 1978; Fazio & Zanna, 1981). The IS literature also generally accepts that past experience including cognitive response to expected benefits can influence how individuals actually use new technology (Bhattacherjee et al., 2004; Pavlou & Fygenson, 2006). Therefore, experience with co-creation can shape future behavior by exerting a directive influence on co-creators' intention on how to react to future co-creation opportunities.

Accordingly, intention constitutes an important mediating factor that influences how co-creators translate expected benefits after taking a co-creation action to achieve those benefits because intention mediates the relationship by helping them plan their contribution while abstaining from other alternatives in pursuing experiential benefits. Hence, we expect that co-creation experience will influence co-creators' actual contributions through positively influencing their continuous intention to contribute to the platform. Therefore, we hypothesize that:

> **H7**: Intention to ideate mediates the relationship between co-creation experience and actual contribution.
>
> **H8**: Intention to collaborate mediates the relationship between co-creation experience and actual contribution.
>
> **H9**: Intention to socialize mediates the relationship between co-creation experience and actual contribution.

4   Methods

We conducted the study in three interrelated phases in order to model, validate, and demonstrate the importance of co-creation experience in SPD networks. We first conducted a case review that guided how we specified the measurement model. Then, we validated the proposed measurement model and tested the hypotheses. In Sections 4.1 to 4.4, we review the research setting and then discuss the methods we followed.

4.1   Research Setting

We sought a research setting that would offer a comprehensive SPD model: that is, a setting that comprehensively represented different aspects of the co-creation experience at the individual co-creator level (see, Hassenzahl & Tractinsky, 2006). Large SPD platforms are still comparatively rare. As one of the first companies to implement such a comprehensive model, Quirky, a socially enabled open-innovation platform, enables its individual members to initiate and fully participate in new product development (Piller et al., 2012; Roser, 2013). As part of the Quirky ideation process, prospective inventors can submit their ideas individually or collaboratively for social evaluation. After they select an idea, network members collaboratively develop and help commercialize it. The company or its partners then produce the developed products and sell them. Quirky compensates the individual contributors involved in the product's co-creation process by paying them a portion of the royalties for each product. As of 2018, more than 1.2 million members had collaboratively developed 150 consumer products and collectively received about US$11 million in royalties. This research setting exemplifies a prototypical—and, at the same time, comprehensive—SPD model due to the high levels of co-creator involvement and the variety of co-creation processes and social engagements. Therefore, the numerous opportunities for co-creation experience on Quirky along with the publicly available data about it provided a rich phenomenon to study (Coelho et al., 2016).

4.2   Identifying and Scoping the SPD Experience Domain

Identifying the experiential benefits should be the first step in quantifying co-creation experience (Park, Han, Kim, Oh, & Moon, 2013). Since, to our knowledge, no research has conceptualized the concept of co-creation experience at the individual level yet, we conducted a case review to identify the experiential

benefits associated with co-creation experience (cf. Yin, 2009). We needed to conduct the case review to identify more accurate categories based on the unique SPD context. From conducting the case review, we could better characterize positive experience in terms of the experiential benefits that co-creators realized throughout the SPD process.

We collected case data from multiple data sources associated with Quirky.com. The first data source comprised our online interviews with active members of the Quirky community (where we defined "active member" as a member with at least three contributions during the last seven days). We sent the interview invitation to 50 randomly selected active Quirky members by using the website's direct message function. From those 50 members, 14 participated in the interviews. In addition, we posted the interview questions on the Quirky forum where 25 members answered the questions. Our second source of data comprised public discussions on member forums—which we did not initiate—where members talked about their experience. The third data source comprised first author's observations of co-creators' contributions, interactions, and relationships across the platform to understand the key SPD activities, which included some references that members mentioned in the forum discussions or during interviews. Our case review provided insights into how co-creators' prior co-creation experience affects their decisions to continue participation in certain co-creation activities.

For the coding, we adopted Nambisan and Watt's (2011) study as a guiding framework to label known experience categories. To interpret the results, we followed Park's et al. (2013) approach to characterize experience construct for model specification. In particular, we took the following steps to collect and analyze the case review data (Yin, 2009): 1) examine the platform documentation for functions, policies, and procedures; 2) extract relevant data points from the Quirky.com forum to list co-creation experience properties and corresponding activities; 3) code data for each co-creation experience into one of four experience levels (emotional, cognitive, behavioral, and social); 4) compare properties for a common language; 5) apply hierarchies to the properties by identifying the key experience categories and their subcategories; 6) cross-validate and verify the emerging categories and subcategories by using the interview data and prior studies; and 7) identify and label each experience category as an independent subdimension based on the empirical observations.

4.3   Measurement Model Specification, Pre-Test, and Pilot Study

We needed to properly specify the measurement model before we could test hypotheses. Therefore, after the case review, we verified how we specified co-creation experience in the measurement model in three phases (Mackenzie, Podsakoff, & Podsakoff, 2011; Vilson & Djamasbi, 2019). First, we pre-tested the scale and subscale for face validity and content validity. To pre-test the items, we administered two rounds of card-sorting with 32 and 30 participants, respectively, in accordance with established guidelines (Moore & Benbasat, 1991). We used this technique to help test the initial conceptualization and validate how we grouped the proposed items. Second, we pre-tested the questionnaire using an expert panel to help ensure that the items were valid in an SPD context (Rubio, Berg-Weger, Tebb, Lee, & Rauch, 2003). The expert panel comprised 10 researchers, 20 graduate students, and five active co-creators from the Quirky community who provided feedback on the survey presentation, structure, and wording. In the third phase, the pilot study, we tested the instrument to establish scale reliability and construct validity for the first-order constructs (Hair, Hult, Ringle, & Sarstedt, 2013). We also used the pilot study to help test indicator validity and multicollinearity for the second-order formative construct (Hair et al., 2013). We drew the sample for the pilot study from the Quirky community and collected data online. In total, we randomly selected 650 Quirky users by generating a list of random ID numbers that corresponded to their profiles and concurrently invited them to participate in the pilot study. The respondents were all active members with at least one month of experience and three weekly contributions to the platform.

4.4   Hypothesis Testing

After validating the measurement model, we tested the relationships between co-creation experience, co-creation behavioral intention (continuous intention to ideate, collaborate, and socialize), and actual contribution. We also tested the mediating effect that continuous intention had on the relationship between co-creation experience and actual contribution. We measured actual contribution according to the number of ideas that participants submitted to the platform a month after the initial survey. We conducted the follow-up questionnaire that assessed Quirky members' actual contribution to respondents who had voluntarily provided an email address or link to their profile.

We collected data for the field survey from a random sample of Quirky members. From 60,000 potential respondents who did not participate in the pilot study, we randomly invited 1,000 Quirky members to participate in an online survey. Similarly to the pilot study, we generated a list of random ID numbers and sent the invitation to the corresponding members. We offered the participants a US$10 gift card as an incentive for each survey completed.

In order to test our model's measurement and structural properties, we employed partial least squares (PLS) using SmartPLS 3.0 (Ringle, Wende, & Becker, 2015). We chose PLS over other analytical techniques because 1) it simultaneously assesses the psychometric properties of the measurement items (i.e., the measurement model) and analyzes the direction and strength of the hypothesized relationships (i.e., the predictive validity model) and 2) it helps one model formative constructs (Chin & Dibbern, 2010; Hair, Ringle, & Sarstedt, 2011). We tested the multiple mediations (H7-H9) in a path model (Preacher & Hayes, 2008) and estimated direct, indirect, and total effects using PROCESS 3.0 (Hayes, 2017). This approach to testing mediation uses the regression coefficients obtained when the equations simultaneously include all aspects of the model (including all covariates). In accordance with Hayes' recommendations, we estimated the standard errors for the 95 percent confidence interval of the indirect effects using the bootstrap resampling method. The bootstrapping method, a nonparametric resampling technique, has more rigor and power than Baron and Kenny's (1986) causal approach (Hayes, 2017; Preacher & Hayes, 2008; Rucker, Preacher, Tormala, & Petty, 2011). The technique allows one to directly measure the indirect effect rather than merely infer that it exists through a sequence of tests (Hayes, 2017). The bootstrapping method also imposes no assumption of the normality of the dataset and, thus, suits studies with small sample size as in our case.

5   Results

We report the results in Sections 5.1 to 5.3. In Section 5.1, we report the measurement model specification based on the results of the case review. In Section 5.2, we present the measurement model-validation process including the pre-test and pilot study results. In Section 5.3, we report the results from testing the hypotheses.

5.1   Measurement Model Specification Results

The Quirky participants mentioned emotional experience more frequently than any other experience type. They described SPD as a constructive hobby and spoke about their co-creation experience as fun, entertaining, and relaxing. Several participants explained their experience as addictively fun and even referred to themselves as "Quirkyholics". Both the user experience literature (e.g., Hornbæk & Hertzum, 2017; Nah & Eschenbrenner, 2015) and open innovation research (e.g., Füller, 2010; Nambisan & Watt, 2011) supports the enjoyment-based aspect in the co-creation experience. Similarly to Kohler et al. (2011), we observed that the playfulness of the SPD process and the challenging nature of co-creation tasks represented the main sources of emotional experience.

The participants also discussed learning as another form of experience. Quirky is a platform for inventors to obtain feedback from other participants and Quirky experts on their ideas. The participants expressed gratefulness that they had a place to express—and learn how to improve—their ideas. Some participants had less concern for the rewards and focused more on developing their personal skills. This participant subgroup mainly cared about 1) learning about their product idea's viability through community feedback, 2) understanding the innovation process and associated challenges with new product development, and 3) developing their entrepreneurial skills through collaborating with other like-minded participants. The co-creation (e.g., Battistella & Nonino, 2012; Lee & Cole, 2003) and HCI literatures (e.g., Greenberg, 2015; Greenberg & Gerber, 2014; Kou, Gray, Toombs, & Adams, 2018) have reported the importance of learning from experience and especially from failure. However, research has traditionally classified experience related to personal development, knowledge acquisition, and learning as a dimension of pragmatic experience rather than as of an independent experience category (e.g., Nambisan & Watt, 2011). Our case review suggests that, in this context, learning experience has sufficiently preeminence to deserve its own category.

Many participants remarked that social interaction with like-minded people formed the core of their experience. Several participants also noted that they kept participating in different projects despite the low chance that they would benefit financially in order to socialize. SPD networks such as Quirky imitate socio-professional networks that allow participants to learn about other participants' interests and

backgrounds, follow their activities, seek and provide support, and even network beyond the platform's activities. Our results concur with prior literature that highlights the prominence of social experience in terms of sociability and sense of community (e.g., Füller et al., 2011; Kohler et al., 2011; Nambisan & Watt, 2011; Nambisan & Nambisan, 2008) and, thus, confirm the importance of examining social experience that the HCI literature has traditionally overlooked (Hornbæk & Hertzum, 2017).

Some participants described SPD as a professional experience that helped them build their reputation and earn recognition in the community that the platform provided and beyond. Nevertheless, not only the successful members endorsed professional experience. Quirky, like other socially enabled innovation networks, promotes the names of inventors in different ways, such as through their public profile webpage, sales platforms, product packages, blog posts, press releases, and even TV programming. Thus, the Quirky community considers the co-creation experience as a reputation-building process that opens up many professional opportunities. The participants also cited the practical aspects of the co-creation experience that allow them to design and launch new products like "professionals" or "inventors" would do. Earlier research has referred to this aspect as pragmatic experience (e.g., Kohler et al., 2011). However, pragmatic experience does not capture the full meaning of professional experience, especially the reputation-building process and search for professional opportunities.

Participants also highlighted utilitarian experience—mainly in terms of tangible financial gain—in the case review since the platform provided monetary incentives to the participants when they successfully ideated and collaborated with others. The process of gaining utilitarian benefits—ranging from profit sharing to indirect rewards, such as product idea feedback—made for a meaningful experience for most participants. While earlier studies suggested the existence a utilitarian aspect of innovation in the form of monetary incentive (Zhang et al., 2015), to our knowledge, no empirical studies have investigated the co-creation experience from this perspective. The utilitarian aspect of collaborative innovation has heretofore been limited to usability concepts (Kohler et al., 2011; Nambisan & Watt, 2011) or information acquisition (Basole & Rouse, 2008). However, neither of these characterizations stood out in our case review because researchers conducted previous studies in customer virtual communities that offered no monetary incentive to participants. One can conceptualize utilitarian experience, an outcome of goal-oriented utilitarian behavior, as direct or indirect financial gain (Hirschman & Holbrook, 1982; Sheldon et al., 2001). Therefore, the new dimension co-creation experience in SPD networks that offer tangible financial benefits constitutes a worthwhile avenue of investigation.

The case review also confirmed that co-creators' experience with the network affects how they evaluated and justified their participation and how they planned their future involvement. The experiential benefits of co-creation also explain why co-creators continued to contribute to the platform even when it failed to meet their initial expectations. Quirky participants explained their experience as a series of values resulting from prior activities and discussed how their experience affects their future contribution. For example, a participant explained that he switched from ideation to collaboration after several failed ideation attempts. Another participant pointed out that she found herself investing more time in socialization than collaboration since she found the former more educational. The case review also showed that the lack of positive experience with compensation, the collaboration process, and the platform's community may affect ideation, collaboration, and socialization, respectively. More interestingly, we found barely any evidence that the platform's usability directly affected participation.

Table 2 summarizes the key concepts that emerged during the case review. We categorized the concepts into five groups: emotional experience, learning experience, professional experience (reputation building), social experience, and utilitarian experience (financial gain). Compared to earlier work, the case review findings reveal the new concept learning experience and suggest splitting pragmatic experience into two categories: professional experience and utilitarian experience. Due to a lack of empirical support, we did not include usability experience in the model specification. This decision also concurs with how we define experience in this study (i.e., as cumulative experiential benefits (outcomes) rather than the interaction process itself). After conceptualizing the co-creation experience as a multidimensional construct, we specified the model for empirical validation, which we describe in the next section.

Table 2. Examples of Co-creation Experience from the Case Review

Categories	Concepts	Examples from Interviews
Emotional experience	• Enjoyable/fun/pleasure • Relaxing • Entertaining • Respect • Satisfaction from problem-solving	• "I just love doing it! For me, it feels more like my art collections!" • "I've had fun. It's been a more enjoyable time than YouTube or Facebook." • "I enjoy researching ideas, mine and others, and discovering products I never knew existed." • "I mostly just do it for what it really is now, a fun time-killing hobby."
Learning experience	• Creativity/curiosity stimulating • Learn new product development • Learn collaboration • Learn the SPD process	• "You can learn something new here every day." • "I also spend a lot of time on here just because I like exercising my brain." • "I also had to teach myself how to do the 3D images and I get quicker every time, and learning a new skill is never wasted time."
Social experience	• Socialization with likeminded people in personal network • Sense of belongingness to a community • Affiliation with the community	• "I am glad like-minded people like us are connected." • "How cool is it to interact with a person half-way around the world? ...I am humbled to be in the company of so many brilliant people." • "A great example of social development and community input working together to take an idea from plateau to peak."
Professional experience	• Reputation for product success • Reputation for ideation/collaboration success • Credibility as an inventor	• "It's my favorite kind of work to do, and the other part would be the recognition and having an idea of mine for sale." • "People get enlightened and strive to turn that enlightenment into something that the world can benefit from…"
Utilitarian experience	• Gain money by collaboration • Gain money by ideation • Gain indirect financial benefits • Investment opportunities • Entrepreneurship opportunities	• "It's all about the money…. I'm purely in it for the \$." • "I wouldn't want to keep doing this on a consistent basis, like a part-time job, unless I was seeing returns." • "[I] have slowly watched the pennies grow on the influence I have earned." • "I treat this like a part-time job now."

5.2   Measurement Model Validation Results

Our case review provided insights into how to contextually operationalize co-creation experience in relation to the key SPD activities in which co-creators engage (cf. Law et al., 2014). As a result, we developed a hierarchical structure to render co-creation experience understandable and measurable in an SDP context (Law et al., 2014; Park et al., 2013). Given the potential interrelationship between experience components and the similarity between the outcomes (Füller et al., 2011; Hassenzahl, 2010), we modeled co-creation experience as a second-order formative construct (cf. Jarvis, Mackenzie, & Podsakoff, 2003) that comprised five first-order reflective constructs that emerged during the case review and that the cognitive psychology literature supports: emotional experience, learning experience, professional experience, social experience, and utilitarian experience (Figure 1). We propose a hierarchical structure for three main theoretical reasons. First, since experiential components are not mutually exclusive (Höök, 2013), Park et al. (2013) proposed the integration of major elements of experience into a single index as a formative construct. Second, experiential benefits (gains) typically have a similar significance among individuals despite the inherent subjectivity with which they experience them (Hassenzahl, 2010). Hence, co-creators have a similar experiential outcome even though they do not have a ubiquitous experience (Hassenzahl, 2010). Third, this approach concurs with earlier studies that assessed user experience by the weighted summation of the major contributing elements (Kim & Han, 2008; Sauro & Kindlund, 2005). These studies showed the theoretical and practical values of this approach in experience analysis, evaluation, and design (Park et al., 2013).

We also used four criteria to justify a formative construct's utility and suitability (Cenfetelli & Bassellier, 2009; Diamantopoulos & Winklhofer, 2001; Jarvis et al., 2003; Petter, Straub, & Rai, 2007): predictability, sensitiveness to exclusion, changeability, and the existence of different antecedents and consequences.

Our study suggested that the five first-order constructs (i.e., the subscales) could exist independently with each dimension of experience partially predicting the level of co-creation experience. Thus, the subscales could substitute for one another in measuring co-creation experience. Omitting any one would alter the definition and comprehensiveness of the higher-order construct (Sauro & Kindlund, 2005). Further, neither empirical evidence nor theory suggest that the five first-order measures should be highly correlated and, thus, interchangeable. Lastly, the five first-order constructs can have different antecedents and consequences. For example, a co-creator may limit their ideation due to limited financial gain but may continue collaborating due to the learning experience.
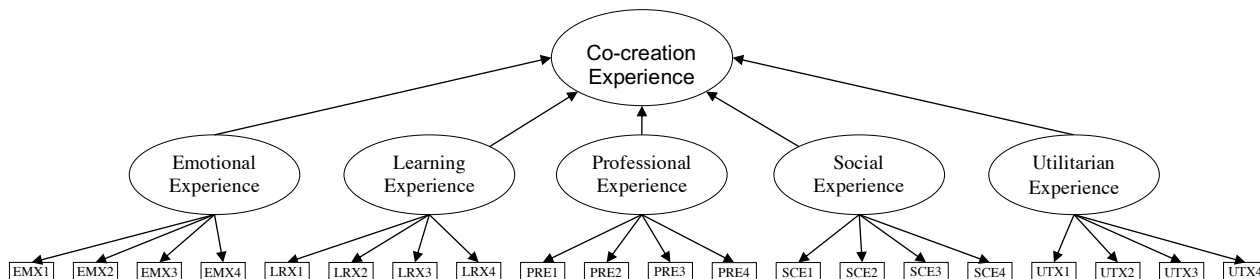
Figure 1. Reflective First-order and Formative Second-order Co-creation Experience Construct in SPD Networks

5.2.1   Pre-test Results

After the model specification, we generated a list of items based on the existing instruments and then adjusted for the study context (e.g., Füller et al., 2011; Nambisan & Watt, 2011). We refined these items in the measurement instrument after a two-step pre-test and a pilot study. First, we examined measurement items through two card-sorting rounds in which we established face validity and confirmed the suitability of the grouping and labeling in the context. Thirty-two researchers familiar with the study context independently sorted each item into the constructs using the provided labels and definitions or marked that it "does not fit any category" or "does not make sense or is confusing". After the first round, we calculated inter-rater reliabilities to identify problematic items. The Kappa scores met the acceptable level of 0.65. The first phase indicated five redundant items, which we removed. After refinement, 30 judges from the Quirky community followed the same card-sorting procedure, and, as a result, we reworded four items.

We pre-tested the questionnaire using the expert panel technique (Creswell, 2013). We included the newly developed co-creation experience items and the continuous intention items—which we adopted from Chen (2007)—in the questionnaire. First, we invited 10 researchers to evaluate the questionnaire for respondent issues (e.g., comprehension or burden) and format issues (e.g., flow, typographical errors, or order effects). We employed a follow-up probe to identify difficulties in completing the questionnaire. At this stage, 20 graduate students completed the questionnaire and commented on potential problems. We considered written and oral comments on the questionnaire in aggregate in order to improve it. Finally, we randomly selected five reviewers from the Quirky community for the third follow-up probe. These Quirky members provided insights into the questions' wording, which facilitated further refinement. By the end of this phase, while we retained all the items, we revised seven questions in order to better reflect the SPD experience and the Quirky context.

5.2.2   Pilot Study Results

Following the questionnaire refinement, we conducted a pilot study to make an initially assess the instrument's reliability. Out of 650 invitations, we received 72 usable questionnaires. We constructed all items as seven-point Likert-scale questions (1 = "strongly agree"; 7 = "strongly disagree") to avoid collapsed variance and maintain consistency. The data were normally distributed, which indicates that we obtained a reasonable sample size for multivariate analysis with PLS (Hair & Anderson, 2010) using SmartPLS (Ringle et al., 2015). We tested the measurement model in two steps: 1) first-order reflective construct examination and latent variables estimation and 2) formative second-order constructs (Hair et al., 2011).

We calculated Cronbach's alpha and performed composite reliability tests to test the data's reliability for the first-order constructs. All the reflective constructs met the reliability criteria that Hair et al. (2013) require. We assessed convergent validity by examining the average variance extracted (AVE). All constructs met the threshold of 0.5. We tested discriminant validity by using the Fornell-Larcker criterion

and examining cross-loadings. Each item's loading on its own construct was higher than all its cross-loadings with other constructs, and the AVE of each reflective construct was higher than the construct's highest squared correlation with any other construct. These tests support the discriminant validity of all the first-order constructs. We identified no issues in the factor-loading evaluation. To evaluate the second-order formative construct, we also assessed the formative measurement items' validity, multicollinearity, and redundancy. We estimated indicator validity using the PLS algorithm method with bootstrapping to calculate item weights and the loading of each formative indicator. The t-values for each item's weight (relative importance) and loading (absolute importance) were significant. Multicollinearity tests showed that each indicator's variance inflation factor (VIF) value was less than the cut-off value of five (Hair et al., 2011).

We conducted a redundancy analysis by correlating each formative construct with a global measure for that construct. Path coefficients exceeded the threshold of 0.80, which supports the second-order formative construct's convergent validity (Hair et al., 2011). Table 3 lists the final measurements as the outcome of the model-specification phase.

Table 3. Final Measurement Items

Subscales	Items
Emotional experience	EMX1: had enjoyable time EMX2: had fun and experienced pleasure EMX3: was entertained EMX4: had relaxing time
Learning experience	LRX1: learned about consumer products usage LRX2: gained knowledge about new product development LRX3: learned about problem-solving LRX4: learned about the co-innovation process
Social experience	SCX1: expanded social network SCX2: strengthened affiliation SCX3: gained a sense of belongingness to a community SCX4: socialized with other like-minded people
Professional experience	PRX1: enhanced professional reputation PRX2: reinforced credibility as an inventor PRX3: developed self-efficacy from new product development PRX4: developed self-efficacy from successful problem solving
Utilitarian experience	UTX1: gained monetary benefits from ideation UTX2: gained monetary benefits from collaboration UTX3: gained (indirect) financial benefits UTX4: gained credits (e.g., purchase, partnership)
Continuous intention to ideate	CII1: continue inventing CII2: continue inventing even when better alternative CII3: discontinue ideation (-) CII4: submit more ideas
Continuous intention to collaborate	CIC1: continue influencing CIC2: influencing even when better alternative CIC3: discontinue influencing (-) CIC4: influence on more projects
Continuous intention to socialize	CIS1: continue communicating/socializing CIS2: communicate/socialize even when better alternative CIS3: discontinue communicating/socializing (-) CIS4: communicate more

5.3 Hypothesis Testing Results

After validating the newly developed co-creation construct, we tested the model. We necessarily re-evaluated the measurement model before testing the hypotheses. Of the 320 Quirky members who responded, we removed 59 responses due to the respondents' lack of co-creation experience (less than one month of experience) or incomplete data, which left a final sample of 261 responses. We also administered a follow-up survey one month after the initial survey to collect data on the respondents' actual contribution. In total, 78 participants submitted acceptable responses to the second survey.

Demographic data analysis shows that the respondents varied in gender, age, education, and employment. We found no non-response bias in comparing respondents' co-creation experience and contributions with the statistics reported on the website. More women (59%) participated in the survey than men (41%). Most of the respondents were between 19 and 65 years old (19-25: 14%; 26-45: 43%; 46-65: 27%), and over 70 percent had at least some college education. Nearly 60 percent of the respondents worked full-time outside participating in the SPD. Further, more than 76 percent of the respondents had more than six months of experience with Quirky (or other SPD networks), and more than 70 percent visited Quirky at least once a week. A majority of respondents had recent experience with ideation (82%), collaboration (100%), and socialization (85%) on Quirky. Over 80 percent of respondents had also received monetary credits for ideation or collaboration: these "influence credits" indicate active participation in SPD.

5.3.1 Measurement Model Assessment: Results

We again tested the measurement model of co-creation experience subscale in two steps. To evaluate the reflective constructs, we tested for indicator reliability, internal consistency, convergent validity, and discrimination validity (Hair et al., 2013). We examined the loadings of the reflective indicators to assess the indicator reliability. We found all constructs to have a "good" to "very good" factor loading (EMX: (0.88-0.91), LRX: (0.87-0.94), PRX: (0.71-0.91), SCX: (0.90, 0.95), UTX: (0.88-0.93)). We assessed internal consistency reliability (construct reliability) by examining the constructs' composite reliability and Cronbach's alpha. Table 4 shows that the constructs had acceptable composite reliability values and Cronbach's alpha values, which demonstrates acceptable internal consistency for the first-order constructs.

We assessed convergent validity using AVE. Researchers generally accept that the AVE of the constructs should exceed 0.5, which means the items share at least half of their variance with the construct (Hair et al., 2011). Table 4 shows that the AVE values of the reflective measurement model of the research exceeded 0.5 with values that ranged from 0.53 to 0.84. These values provide evidence that our measures displayed convergent validity and robustness. We evaluated the model's discriminant validity by examining the cross-loading for each indicator. We found that each indicator had a higher loading on its own construct than other constructs, which indicates adequate discriminant validity. As secondary evidence of discriminant validity, the AVE of each reflective construct was higher than the construct's highest squared correlation with any other construct. The heterotrait-monotrait (HTMT) ratio of correlations values was also below 0.90, which suggests discriminant validity (Henseler, Ringle, & Sarstedt, 2014). To summarize, the cross-loadings, the Fornell-Larcker criterion, and the HTMT ratio established discriminant validity.

Table 4. Internal Consistency Reliability and Latent Variable Squared Correlation

Factor	Composite reliability	Cronbach's alpha	AVE	EMX	LRX	PRX	SCX	UTX
Emotional Experience	0.931	0.920	0.781	**0.884**				
Learning Experience	0.937	0.911	0.824	0.442	**0.908**			
Professional Experience	0.949	0.929	0.686	0.712	0.406	**0.828**		
Social Experience	0.899	0.855	0.837	0.683	0.360	0.700	**0.915**	
Utilitarian Experience	0.954	0.935	0.830	0.393	0.367	0.494	0.421	**0.911**

We also tested for common method bias using a full collinearity assessment (i.e., vertical and lateral collinearity) (Kock, 2015). Since all pathological VIFs that resulted from a full collinearity test were lower than 3.3 (1.32-2.65), we considered the model as free from common method bias (Kock & Lynn, 2012). Harman's single-factor test also showed neither a single factor nor one general factor accounted for most of the covariance among the measures (Sharma, Crawford, & Yetton, 2009). Therefore, we found no substantial common method variance.

We assessed the second-order formative construct for indicator validity following the Hair et al.'s (2011, 2013) recommendations. We estimated this validity using the PLS algorithm method with bootstrapped samples. We used each item's weight, loading, and associated t-value from bootstrapping to assess the item's significance (Table 5). We found that the second-order formative weight was not significant for professional experience. However, we retained these items to preserve the subscales' content validity (Cenfetelli & Bassellier, 2009; Hair et al., 2013; He, 2013).

Table 5. Second-order Construct Weights and Loadings

Factor	Loading	t-value	Weight	t-value
Emotional experience → co-creation experience	0.916	21.908	0.501	3.464
Learning experience → co-creation experience	0.625	6.517	0.199	1.922
Professional experience → co-creation experience	0.816	14.223	0.117	1.172
Social experience → co-creation experience	0.829	13.658	0.258	1.989
Utilitarian experience → co-creation experience	0.611	8.648	0.176	2.167

To investigate how each dimension contributed to co-creation experience, we applied the factor weighting scheme in SmartPLS. The results showed that all the first-order constructs significantly contributed to forming the second-order construct (EMX: 0.278; LRX: 0.209; PEX: 0.288; SCX: 0.280; UTX: 0.219; p < 0.001). This finding confirms the practical importance of all the first-order constructs in defining the co-creation experience.

We then evaluated the formative constructs for multicollinearity. Multicollinearity tests showed that each indicator's VIF value did not meet the cut-off value of 5.0 (EMX: 2.46; LRX: 1.32; PEX: 2.652; SCX: 2.29; UTX: 1.340). Following Hair et al.'s (2011) general guidelines, we retained all formative indicators in this measurement model as they were not highly correlated. We conducted redundancy analysis to establish convergent validity by correlating each second-order construct with a single-item global measure for that construct. The path coefficients exceeded the threshold of 0.80 (p < 0.05), which indicates convergent validity (i.e., no redundant variables) (Hair et al., 2011).

In addition to the co-creation experience construct, we adopted the measurement items for continuous intention from Chen (2007). The evaluation of continuous intention items involved testing construct reliability and construct validity. Table 6 shows that all the loadings of measurement items on their latent constructs exceeded 0.7, which indicates acceptable item reliability (Hair et al., 2013). In addition, the value for Cronbach's alpha (0.880-0.894) and the composite reliability (0.926-0.934) of all the constructs exceeded 0.7, which indicates good internal consistency among the items measuring each intention construct (Hair et al., 2013). We used three criteria to assess convergent validity and discriminant validity: 1) all average variance extracted values (0.785-0.825) exceed 0.50 (Hair et al., 2013), 2) the square root of the AVE of each constructs (0.898-0.908) exceeds the correlation of this construct with any other construct (Fornell & Larcker, 1981), and 3) the correlations among all constructs (i.e., inter-construct correlations) all fall well below the 0.90 threshold (Hair et al., 2013). The results from these tests suggest adequate convergent and discriminant validity.

Table 6. Internal Consistency Reliability and Latent Variable Squared Correlation

Factor	Composite reliability	Cronbach's alpha	AVE	CII	CIC	CIS
Continuous intention to ideate (CII)	0.934	0.894	0.825	**0.908**		
Continuous intention to collaborate (CIC)	0.926	0.880	0.807	0.741	**0.898**	
Continuous intention to socialize (CIS)	0.931	0.889	0.785	0.511	0.538	**0.904**

5.3.2 Structural Model Assessment: Results

We tested the hypotheses with control variables that may affect co-creation experience; namely, "number of visits per week", "length of experience with SPD", "length of experience with the platform", and "number of past contributions". To test the model, we first examined the significance of the direct effect of co-creation experience on continuous intention to ideation, collaboration, and socialize. The results revealed that co-creation experience was positively associated with continuous intention to ideate ($\beta = 0.374$, p < 0.001), to collaborate ($\beta = 0.439$, p < 0.001), and to socialize ($\beta = 0.622$, p < 0.001). The findings support H1, H2, and H3 (Table 7). Co-creation experience's predictive relevance (Q^2) in the presence of the control variables confirmed the importance of co-creation experience in predicting continuous intention to ideate ($Q^2 = 0.303$), collaborate ($Q^2 = 0.303$) and socialize ($Q^2 = 0.368$). Further, from comparing the effect size (f^2) for continuous intention to socialize, ideate, and collaborate, we found that co-creation experience had a stronger determining effect on continuous intention to socialize ($f^2 = 0.681$) than continuous intention to ideate ($f^2 = 0.211$) or to collaborate ($f^2 = 0.323$).

We tested H4 through H9 via a follow-up survey that we administered one month after the initial survey. Hence, the following analysis relies on a subset of data that included responses from both surveys. We used the same control variables as above. The continuous intention to ideate ($\beta = 0.259$, $p < 0.05$), collaborate ($\beta = 0.434$, $p < 0.01$), and socialize ($\beta = 0.240$, $p < 0.05$) exerted significant impact on co-creators' actual contributions to the SPD network. Therefore, the results support H4 through H6. The results from analyzing this data subset again support the significant relationships between co-creation experience and continuous intention to ideate ($\beta = 0.406$, $p < 0.001$), collaborate ($\beta = 0.443$, $p < 0.001$), and socialize ($\beta = 0.772$, $p < 0.001$), respectively.

We also tested the role that continuous intentions to ideate, collaborate, and socialize had in mediating the influence that co-creation experience had on actual contribution (H7 to H9). Again, we used the sample subset that we used to test the mediation effects due to the relatively large effect sizes we observed (Fairchild, Mackinnon, Taborga, & Taylor, 2009). We tested the mediation according to the bootstrapping procedure that Hayes (2017) suggests. In this study, we obtained a 95 percent confidence interval of indirect effects with 10,000 bootstrap resamples using the SPSS macro PROCESS version 3.0 (Hayes, 2017). The results reveal that perceived continuous intentions to ideate, collaborate, and socialize significantly carried the influence of the independent variable (co-creation experience) on the dependent variable (actual contribution). The bootstrapping results confirmed that that co-creation experience significant predicted continuous intention to ideate ($\beta = 0.406$, SE = 0.093, CI = 0.220 – 0.592), collaborate ($\beta = 0.443$, SE = 0.084, CI = 0.276 – 0.610), and socialize ($\beta = 0.772$, SE = 0.094, CI = 0.585 – 0.958). Meanwhile, continuous intention to ideate ($\beta = 0.259$, SE = 0.128, CI = 0.003 – 0.515), collaborate ($\beta = 0.434$, SE = 0.142, CI = 0.152 – 0.717), and socialize ($\beta = 0.240$, SE = 0.099, CI = 0.042 – 0.437) significantly predicted actual contribution to the SPD.

These results indicate that the indirect effect size of co-creation experience on actual contribution was significant across continuous intention to ideate (0.105, SE = 0.114, CI = 0.022 – 0.222), continuous intention to collaboration (0.192, SE = 0.075, CI = 0.071 – 0.365), and continuous intention to socialize (0.185, SE = 0.082, CI = 0.025 – 0.354). These findings support H7 to H9. The results also support with full mediation since co-creation experience no longer significantly predicted actual contribution after we controlled for the mediator (i.e., continuous intention to ideate, collaborate, and socialize) ($p = 0.279$).

Our model explained 64 percent of the variance in actual contribution ($R^2 = 0.643$) of which the indirect effect of co-creation experience explained 48 percent. The effect size of co-creation experience was 0.358, which explains the total influence of co-creation experience on actual contribution. This effect size is high as per Cohen's (1988) guidelines, which define effect sizes as small (0.01), medium (0.09), and large (0.25). We summarize the results from testing the hypotheses in Table 7 and Figure 2.

Table 7. The Relationships Between Co-creation Experience, Continuous Intention to Ideate, Collaborate, Socialize, and Actual Contribution

| Model	Effect size	SE	t	LLCI	ULCI	R^2
Model without actual contribution						
H$_1$: CCE → CII	0.374	0.066	5.663***	0.252	0.518	0.400
H$_2$: CCE → CIC	0.439	0.073	5.995***	0.299	0.583	0.459
H$_3$: CCE → CIS	0.622	0.052	11.961***	0.523	0.719	0.486
Model with actual contribution and continuous intention constructs as mediator						
CCE → CII	0.406	0.093	4.342***	0.220	0.592	0.346
CCE → CIL	0.443	0.084	5.278***	0.276	0.610	0.532
CCE → CIS	0.772	0.094	8.242***	0.582	0.958	0.770
CCE → AC	0.124	0.114	1.091	-0.351	0.103	n/a
H4: CII → AC	0.259	0.128	2.015*	0.003	0.515	n/a
H5: CIC → AC	0.434	0.142	3.067**	0.152	0.717	0.643
H6: CIS → AC	0.240	0.099	2.416**	0.042	0.437	n/a
Indirect effect††						
H7: CCE → CII → AC	0.105	0.051	n/a	0.022	0.218	n/a
H8: CCE → CIC → AC	0.192	0.075	n/a	0.071	0.369	n/a
H9: CCE → CIS → AC	0.185	0.082	n/a	0.025	0.354	n/a
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. † Based on the second survey. †† Bootstrap results.						
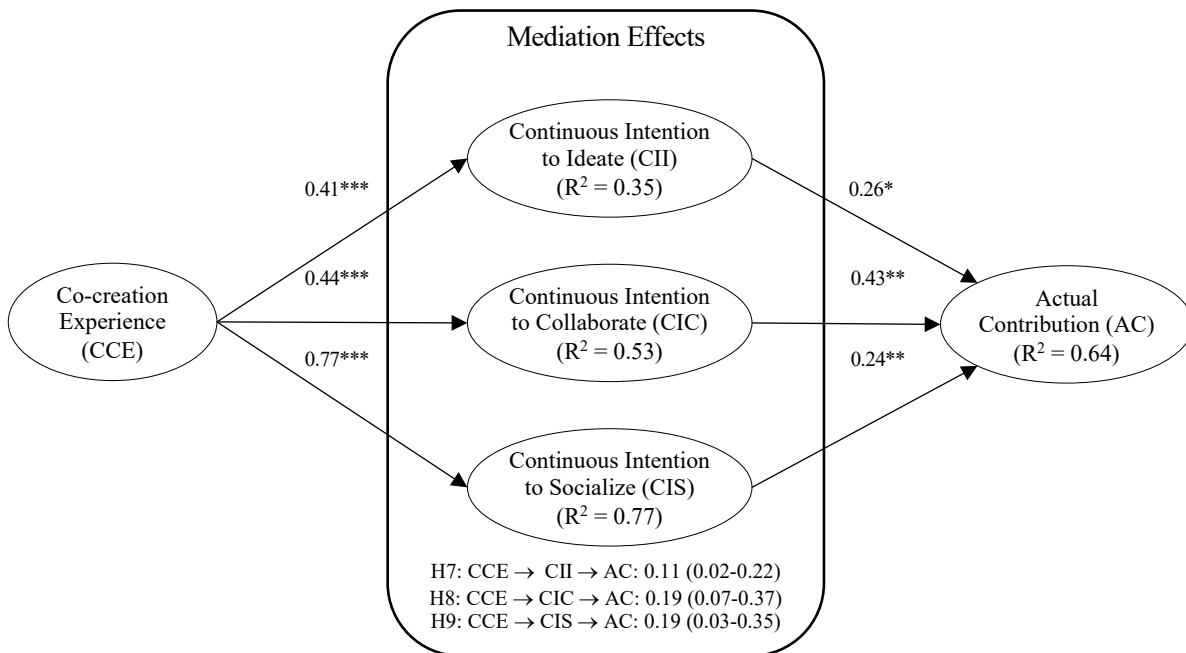
Figure 2. Structural Model Assessment Results

6   Discussion

We conducted this study to better understand co-creation experience in SPD networks—a unique and understudied form of open innovation that makes innovation accessible to individual co-creators. Based on arguing that co-creation experience constitutes a crucial factor to SPD networks' viability, we proposed and validated a new and inclusive operationalization for co-creation experience and demonstrated its significant effects on intention to ideate, intention to collaborate, intention to socialize, and actual contribution.

In conceptualizing co-creation experience, we go beyond the usability of SPD platforms—as UX research typically discusses—and shifts the focus to the SPD process's experiential benefits. In line with recent developments in HCI literature (Law et al., 2014; Wani, Raghavan, Abraham, & Kleist, 2017), we argue that better understanding SPD's experiential benefits can offer a deeper theoretical understanding for modeling co-creation experience and also potentially guide practical frameworks for designing SPD platforms.

We then operationalized co-creation experience as a hierarchical structure (second-order construct) based on the results of our preliminary case review and the literature recommendations (Law et al., 2014; Park et al., 2013). The key components that emerged during the case review aligned well with the literature (Füller et al., 2011; e.g., Kohler et al., 2011; Nambisan & Watt, 2011). However, we introduced learning experience as a new dimension of co-creation experience and revisited the concept of pragmatic experience by suggesting two new categories (i.e., professional experience and utilitarian experience). The final model comprised a second-order construct with five first-order reflective constructs rendering key experiential benefits: emotional experience, learning experience, social experience, professional experience, and utilitarian experience. We took a more holistic and contextual approach to measuring co-creation experience and integrated these key constructs into a single index (cf. Kim & Han, 2008; Sauro & Kindlund, 2005).

After model specification, we pre-tested and pilot tested the proposed operationalization and then validated the resultant construct in an actual SPD network. This study confirms suggestions in the literature about the importance of hedonic and social experience (e.g., Kohler et al., 2011; Nambisan & Watt, 2011). It also speaks to the previously unexplored aspects of co-creation experience in SPD networks such as learning experience, professional experience, and utilitarian experience and, thus, offers

a more inclusive instrument to measure them. The results of the PLS weighting scheme analysis revealed the significant and relatively similar contribution of all five dimensions to the co-creation experience construct. This finding validates co-creation experience dimensions as components of a second-order formative construct that aligned well with the results that Füller et al. (2011) report for corporate-sponsored open innovation.

The study also demonstrates the importance that co-creation experience has in enhancing an SPD network's outcomes and, therefore, contributes to explaining the mechanisms that drive actual contribution in SPD networks. We first showed the significant influence of co-creation experience on continuous intention to ideate, collaborate, and socialize—three main SPD activities. The results confirmed the predictive relevance of all three constructs. However, in comparing their effect size, we found that co-creation experience had a more determining effect on continuous intention to socialize than continuous intention to ideate and collaborate had. The follow-up survey also revealed the significant effect that co-creation experience had on actual contribution by promoting intention to ideate, collaborate, and socialize. The test of mediation effects confirmed that co-creation experience can change behavioral intentions and, thereby, affect actual contribution in SPD networks. The weak direct effect that co-creation experience had on actual contribution suggests that individuals' experience-driven intention determines co-creators' contributions to an SPD network more than experience does directly. The large effect sizes we observed suggest that an SPD platform's experiential aspects have much importance in explaining post-adaptation behavior and contribution level.

Our findings about co-creation experience in the interactive SPD context contributes to research and practice in several ways. In Section 6.1, we discuss how this study enriches experience theory as it pertains to SPD and, in Section 6.2, provide practitioners with guidance for developing and governing SPD in practice.

6.1   Theoretical Contributions

First, this paper responds to calls for more research on the experiential aspects of computing (e.g., Alter, 2010; Hylving, 2017; Yoo, 2010) and, in particular, to calls for a more plausible approach to modeling user experience (e.g., Law et al., 2014). This study also helps to expand the co-creation experience concept for UX research (Hassenzahl, Diefenbach, & Göritz, 2010; Law et al., 2014; Tuch, Trusell, & Hornbæk, 2013). We contribute noteworthy research to the literature since researchers have previously understood co-creation experience based mainly on assumptions borrowed from studies in e-commerce, value network theory, and education. Our approach to operationalizing experience complements earlier work on UX evaluation methods related to system design (Obrist et al., 2011; van Schaik, Hassenzahl, & Ling, 2012; Vermeeren et al., 2010) and co-creation platform evaluation (Kohler et al., 2011).

Second, authors in the IS and HCI literatures usually focus on either hedonic or productivity-oriented technology rather than on platforms that provide both (Lin & Bhattacherjee, 2010; Turel, Serenko, & Bontis, 2010). Studies in these literatures have limited constructs that represent a technology's experiential components to enjoyment or affection up until recent works in UX (Tuch & Hornbæk, 2015). Additionally, one cannot fully transfer previous studies limited to virtual customer communities (e.g., Nambisan & Watt, 2011) to an SPD context since they have mainly investigated "customer engagement" in product-improvement programs rather than "social co-creator participation" in new product development. Our work addresses these two gaps by proposing an integrated, holistic approach to render the experiential aspects of new technology use.

Third, this research addresses limitations in quantifying co-creation experience (Law & Van Schaik, 2010). The measurement model we propose helps break down the complexity of the concept and facilitates future experience research by modeling experiential benefits as cumulative outcomes of previous interaction with SPD platforms. Offering a measurement model for co-creation experience also contributes to UX theories by enabling modeling experiences in different contexts. Measuring co-creation experience helps break down the complexity of co-creation experiences into evaluative constructs (Pucillo et al., 2014) by offering a single index to rate individual co-creation experience (Kim & Han, 2008; Sauro & Kindlund, 2005).

Fourth, by focusing on co-creation experience, we could explore the experiential component of human-computer interactions in a new context. We ground our proposed framework in robust theories and empirical evidence, and it indicates the experiential outcomes of co-creation in supporting the viability of SPD networks. Unlike prior studies, we go beyond distinguishing between the cognitive and affective

elements of open innovation to encompass other experiential benefits such as social benefits (e.g., Hornbæk & Hertzum, 2017). With our study, we affirm that co-creator experience plays an important role in retaining participants in SPD networks by examining and explaining the underlying mechanisms and contributing factors. Other researchers can use the measurement model we propose here to investigate how the co-creation experience affects intentions to ideate, collaborate, and socialize. By reporting on the context (including individual co-creators and the activities in which they engage), we provide a reliable foundation for future investigations into the co-creation experience and its relationship with other SPD performance indicators.

Lastly, we offer empirical support for the mediating role that continuous intention has on the relationship between co-creation experience and actual contribution. This finding indicates that continuous intention to ideate, collaborate, and socialize could result from a proposal made to co-creators in terms of experiential opportunities such as learning and networking and not necessarily an imposition derived from platform features or usability. This finding supports the "experience-first" approach and signifies the superiority of experience design over interaction design (Javahery & Seffah, 2012).

6.2   Practical Contributions

This study affirms that SPD networks need to offer engaging co-creation experiences to maintain external participation. While SPD sponsors may be interested in enticing creative contributions, co-creators care about the experience on the platform. Therefore, to engage co-creators in SPD, SPD sponsors can provide compelling experiences aligned with the network's goals. If SPD sponsors fail to create these compelling experiences, co-creators may limit their contributions, withdraw from projects, or switch to other networks.

By broadly conceptualizing co-creation experience, our study provides a richer picture of the SPD process than previous literature affords and, thereby, can assist SPD sponsors in in designing platforms. While previous studies have focused solely on explaining interactional factors (such as the source of experiences), our study emphasizes the importance of total experience design. We suggest that SPD sponsors need to offer various co-creation experience opportunities that offer gains such as enjoyment, learning, networking, and professional recognition. For example, SPD platforms with an open and constructive environment may help co-creators form positive social experiences, which may lead to a higher knowledge-sharing rate through socialization with other co-creators. This finding offers a new approach to designing platforms that goes beyond typical participatory or contextual design practices by emphasizing experience design rather than platform features. This approach to designing platforms can prevent SPD sponsors from overinvesting in platform features that may have only limited value in improving co-creators' participation and contribution.

Our systematic and comprehensive approach to quantifying experience provides practical value to those pursuing SPD governance, evaluation, and improvement. Using the proposed instrument, SPD sponsors can understand different experiential factors across the network and highlight benefits by adjusting the relevant processes, incentives, and policies, which can help them attract more co-creators and maintain network outcomes. Although the high score that we found for the overall co-creation experience index does not guarantee the superiority of prior interaction with the platform, SPD sponsors could use the quantitative value as a potential indicator of experience quality for more effective governance. From a retention perspective, SPD sponsors should devote more resources toward creating a positive co-creation experience that can aid positive disconfirmation and promote higher satisfaction than, for example, artificially inflating co-creators' expectations by offering new features (Bhattacherjee et al., 2004).

Finally, we linked co-creation experience to co-creator behavioral intention and actual contribution, which promises to help SPD governance. For example, understanding the five SPD experience categories that we identified can help SPD sponsors to acquire, encourage, and retain external co-creators more efficiently, which can lead to better business outcomes. The experience measurements have prescriptive value for SPD process evaluation and re-engineering (e.g., in redesigning a system for higher performance and sustainability).

7 Limitations and Future Studies

We propose a novel and comprehensive model to capture co-creation experience in SPD networks and demonstrate the importance of this model in explaining the viability of these networks. Future research that builds on our work should consider the following research opportunities.

Although we developed our experience model such that one could easily adapt it across different business models, one should conduct additional checks for validity and reliability. We investigated co-creation experience in a field survey of individuals who actively participated in an SPD platform. While this approach strengthens the external and ecological validity of the study in the SPD context, we advise caution when generalizing our empirical findings to other open innovation settings (Lee & Baskerville, 2003). For example, further investigation is needed with other models, such as the innovation-marketplace and crowdsourcing, to evaluate the model's transformability and its impacts on behavior. We also suggest that researchers employ the proposed instrument to develop new, more rigorous studies to further clarify the role of other experiential benefits.

The proposed construct can also help researchers model the co-creators' decision-making process, which involves judgments about future benefits based on prior experience. In this research, we focus on positive experience. However, future research needs to examine negative experiences and how they influence co-creation behavior. For example, it would be beneficial to understand how negative experiences affect the perceived risks of co-creation and, ultimately, affect co-creation behavior.

From a design science perspective, future research can uncover why co-creators use different features to co-create experiences and how they benefit from these features. While many researchers have studied the antecedent factors of co-creation experience, such as interaction and usability, few conceptual studies have discussed the influence that experience has on how co-creators perceive technology. Therefore, research has yet to empirically explain the mechanism for how co-creators' interactions affect how they perceive design. Moreover, researchers need not only explain mechanisms but also discuss how to design platforms more effectively based on the research findings—in this case, the experiential benefits and their impact on the level of contribution.

The exploration of factors moderating the relationship between co-creation experience and behavior could be another interesting research avenue. We hope that our findings stimulate further research on the relevance of co-creation experience management in SPD contexts. Future research can make SPD more fulfilling for creative individuals and, thereby, unlock its value to the economy and society.

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